PRESENTED

BY

J. A. Nunneley. Esqr.

1900

William [illegible]

Leeds

LEEDS UNIVERSITY LIBRARY

Classmark:

Special Collections

Health Sciences Historical Collection

SC2 MON

30106016199969

Digitized by the Internet Archive
in 2015

https://archive.org/details/b21522431

OBSERVATIONS

ON THE

CAUSES

WHICH DETERMINE THE FORM

OF THE

HUMAN SKULL,

BY

ALEXANDER MONRO *jun.*, M. D. F. R. S. E.;
PROFESSOR OF MEDICINE, ANATOMY AND
SURGERY, IN THE UNIVERSITY OF
EDINBURGH.

OBSERVATIONS

ON THE

CAUSES WHICH DETERMINE THE SHAPE OF THE SKULL.

Before proceeding to a detailed account of the causes which determine the shape of the skull, it may not be improper to premise a few general observations respecting the position of the human head in relation to the spine; and also upon the size and form of the human skull.

Of the position of the Human Skull with regard to the Spine.

The skull is pretty nearly equipoised upon the spine; the foramen magnum ossis occipitis, being nearly in the centre of the basis of the skull. Thus the skull is firmly fixed on the point of support, in the erect posture; whereas, in most quadrupeds, the foramen magnum occipitis, is placed at the back of the head; or the head is connected to the neck, by its back-part, instead of the middle of its basis, and hangs, as it were, before the neck; by which quadrupeds, when in the horizontal posture, can seize what is before or above them, and, by depressing the head and neck, can reach the ground with the mouth.

Of the size and form of the Head.

The cavity of the cranium is proportioned to its contents; and hence there is much variety as to the size of the head, and also as to its form in different subjects. It is neither so broad, nor so deep at its fore-part, in which the fore-part of the brain is lodged, as at its back-part in which the back-part of the brain and smaller brain are lodged.

The skull, generally speaking, is somewhat like an egg in its shape, with the broad end behind; but there is much variety even among the individuals of the same nation, as to this circumstance, of which Plate xvi affords very strong evidence.

The greatest diameter of the cranium, is from the fore-head to the hind-head, and is equal to somewhat more than six inches, and the greatest transverse diameter is between four and five inches and a half; and the greatest perpendicular is from the vertex to the foramen magnum occipitis.

In order to determine more accurately these different diameters, I was at some pains in measuring these in a number of skulls; of which the following is the result.

TABLE I.

MEASUREMENTS of Skulls of Britons, with the Alveolar processes and Teeth.

Greatest Breadth.	Greatest Length.	
5	$6\frac{5}{10}$	
$4\frac{9}{10}$	$6\frac{2}{10}$	
$4\frac{9}{10}$	$6\frac{4}{10}$	
$4\frac{8}{10}$	$6\frac{2}{10}$	
$4\frac{5}{10}$	$6\frac{5}{10}$	*Lunatic.*
$5\frac{9}{10}$	$6\frac{8}{10}$	
$5\frac{5}{10}$	$6\frac{5}{10}$	
$5\frac{2}{10}$	$6\frac{5}{10}$	
$5\frac{6}{10}$	$6\frac{3}{10}$	
$5\frac{2}{10}$	$6\frac{5}{10}$	
$5\frac{2}{10}$	$6\frac{6}{10}$	
$5\frac{5}{10}$	$6\frac{9}{10}$	

TABLE II.

MEASUREMENTS of British Skulls where there were no Teeth and where the sockets of the Teeth had also disappeared.

Greatest Length.	Greatest Breadth.
6	$5\frac{4}{10}$
$6\frac{9}{10}$	$5\frac{6}{10}$
$6\frac{9}{10}$	$5\frac{2}{10}$
$6\frac{4}{10}$	5
$6\frac{}{10}$	$5\frac{1}{10}$

TABLE III.

MEASUREMENTS taken from the inside.

Greatest Length.	Greatest Breadth.
$6\frac{2}{10}$	$5\frac{3}{10}$ *Russian.*
$6\frac{2}{10}$	$4\frac{7}{10}$ *Lascar.*
$6\frac{5}{10}$	$4\frac{8}{10}$ *Turk.*
$6\frac{6}{10}$	$5\frac{2}{10}$ *African.*
$6\frac{4}{10}$	$4\frac{6}{10}$
$6\frac{4}{10}$	$5\frac{2}{10}$

Explanation of Plate XVI.

This plate, which was copied from a drawing by my able assistant and friend Mr Fyfe, represents accurate outlines of the skull-caps of five skulls of Britons, in order to point out the differences as to their form.

The figures placed upon the outlines of the different skull-caps, sufficiently distinguish the one skull-cap from another.

* * *

I also requested of Dr W. E. Leach to measure several of the skulls in my possession, of different nations, with a *craniometer* invented by himself[*]; with which request he readily complied, and made out for me the following table:

---

[*] Dr Leach proposes, in the Edinburgh Encyclopædia, to publish an account of his *craniometer*, which is extremely well adapted for measuring the different angles of the skull.

TABLE IV.

MEASUREMENT OF SKULLS.

Kind of Skull.	Superior basi-facial angle.	Inferior basi-facial angle.	Inio-glabellar diameter.		Anterior transverse diameter.		Posterior transverse diameter		Distance of the foramen magnum from the Inion.		Corono-basilar diameter.	
	Degrees.	Degrees.	Inch.	10ths	Inch.	10ths.	Inch.	10ths.	Inch.	10ths.	Inch.	10ths.
A European female,	73½	50	7	8	3	8	5	8	2	3½	4	2
A European female,	73½	0	6	0	4	0	5	5	2	3	4	5½
A European male,	74	51	6	9	4	1	5	2	2	7	5	5
Russian male, - -	74	50½	7	0	4	4½	6	0	2	6	5	5
Negro male, - -	72½	47	7	2	3	7	5	3	2	2	5	7
Negro male, - -	69	41	7	2	4	2	5	7	2	4	5	2
Lascar male, - - -	72½	0	6	5	3	4	5	8	2	0	5	8½
Carib. (male ?) - -	61	0	6	0	3	7	5	2	2	3	5	4
New Hollander (male ?)	0	0	7	3	3	9	5	1	2	8½	5	6
Esquimaux, - - -	0	0	7	0	3	9	5	3	2	8	5	6
Hindoo, - - - -	81	62	6	8	3	3	4	5	2	4	4	4
A curious skull in the College Museum, supposed to be that of a Mummy, as it is filled with pitch.	0	0	8	1½	4	1½	4	5	0	0	0	0
Hottentot, - - -	0	0	7	0	4	0½	0	0	2	7	6	0

Dr BLUMENBACH of Göttingen *, after enumerating his objections to the methods which DAUBENTON, ALBERT DURER, and CAMPER have proposed for pointing out the national peculiarities of skulls, has proposed the following method, which he thinks less objectionable. He arranges his crania on a table in a row, and contemplates them behind: thus he observes the breadth and narrowness of the forehead, its arched or flat form, and the direction of the jaws and cheek-bone; and this he has called his *norma verticalis*.

But such a view may be said to be partial; and it does not present to us many of the important differences in the form of the bones of the face, especially the very different form of the orbits, and many other peculiarities in the upper jaw.

With regard to BLUMENBACH's figures, it may be observed, that these are but poorly drawn and engraved, and communicate a very general idea of the form of the skull, but not of its smaller parts; and besides, different skulls cannot be well compared, as they are not represented in the same point of view.

In these circumstances, I thought it necessary to subjoin plates xvii, xviii, xix, and xx, which were very faithfully drawn by Dr CAMPER and Mr LIZARS, and I trust that these representations communicate a more perfect idea of the peculiarities of these skulls, than the most laboured verbal description could afford.

---

* Vid. Jo. FRID. BLUMENBACH, Decad. Crainor. Gotting. Vid. also his Treatise *De Generis Humani varietate nativa.*

Of the causes which determine the form of the cranium, and of thosecauses which lead to an alteration in its shape.

There is no part of the human skeleton which is more variable in its shape, its size, and the proportion of its several parts, than the skull, and even amongst the inhabitants of the same nation.

There are some of the causes of these very remarkable differences in the skull which may be readily explained.

The form of the skull is determined by the soft parts, in proof of which, the internal table of the skull takes the exact impression of the convolutions of the brain and cerebellum, of the glands of Pacchioni, of the ramifications of the arteries of the dura mater, and its external surface displays impressions of the action of the external muscles, as well as traces of the form of the features *.

---

* As the internal table of the skull only bears the impression of the convolutions of the brain and cerebellum, hence the external surface of the skull is not elevated by any part of the surface of the brain. This circumstance is a very strong objection to Gall's doctrine, who supposes that the peculiar propensities of the individual, are indicated by the particular form of a certain part or parts of the skull.

Professor Dumas of Montpelier, in his *Observations sur la Physionomie propre à queleques maladies chroniques,* has paid

But some anatomists do not subscribe to such an opinion, and suppose that the skull serves not only to limit the growth of the brain, but also to determine its peculiar shape. I confess that the former seems to me the more rational hypothesis.

That the cranium owes its shape chiefly to the extension of the contained parts, and the resistance of the external organs, seems proved, or at least rendered probable, as the brain and cerebellum of the fœtus are formed, long before the skull, and it is impressed by the brain.

It may be readily supposed, that the bones of the skull, which in the fœtal state are formed between the pericranium and dura mater, and which are originally in a soft and elastic state, should take on the shape of their contents.

The ossification of the skull goes on but slowly: it is not completed until the child has attained its third or fourth year, and often not until a later

---

much attention to the form of the head in different diseases. He has said, that in the phthisical, there is a shining brightness of the eyes, a lengthening of the line between the orbits, and a hollowness about the temples. From hydrocephalus chronicus, that the eye is thrust forward, and half of it hid under the eye-lid, and that the visage is enlarged, and altered from its natural shape.

In the scrofulous, the head is enlarged, particularly about the occiput. And he has added, that when epilepsy is connected with an organic defect of brain, this is peculiarly marked by the facial angle of 70° to 71°. In one case he observed it below 70°. Such patients, according to him, are not curable, but the epilepsy is curable when the facial angle amounts to 80°.

period: hence the bones, which are not so hard as in advanced life, more readily receive and retain the impressions of the convolutions, and other projecting parts of the brain, and are so impressed by these, that, by an attentive examination, it is easy to determine, what part of the skull has been most acted on.

Thus, upon comparing the top with the base of the skull, the latter is found very unequal in its surface, as it not only resists the extension of the brain, but also supports its weight.

Further, these impressions in the base of the skull become deeper during the progress of life.

As *general pressure* produces so manifest a change upon the form of the skull, pressure *partially applied*, may also lead *to the distortion of the skull*; and hence the skull will be expanded in the direction to which the head is inclined.

The brain of a child, by particular posture, presses more on the one part of the skull than the other. If the head be unequally balanced on the spine, it will expand in the direction to which it inclines, and one side of the skull becomes considerably more capacious than the other. This may arise from an awkward way of standing, from one leg being longer than the other, from wry neck, or any other cause which keeps the head constantly inclined to one side.

Dr Camper has published the case of a young woman, which shews clearly the effect of pressure: his patient carried her head to one side, so that the brain lodged principally upon the orbit of the lower side, in consequence of which, the eye was lower down in the face than the other, and the fore-head assumed a very peculiar appearance.

That the bones derive their form from the softer parts, is also obvious, *from the remarkable alteration in the form of the jaws when the teeth have fallen out.*

The roof of the mouth, which was arched, becomes flat; the cavity of the mouth is therefore diminished, and sufficient space is not left for the tongue, and hence it is protruded out of the mouth when it is moved forwards even slightly, and it appears longer.

The distance of the chin from the nose *becomes shorter by one-sixth part of the length of the head,* and the nose and chin seem to touch each other.

The pulps of the teeth also *determine the figure of the teeth,* in the same manner as the brain determines the form of the skull.

The pulps have acquired the same form as the complete teeth, before the ossification of the teeth has begun.

When the ossification of the body of the tooth has been in part completed, the pulp is elongated, and upon the elongated pulps, the roots of the teeth are formed.

The above circumstances, seem to me to prove, that *the internal distention is the primary cause of the form of the skull and teeth.*

The influence of external pressure is also to be taken into account, which is sometimes so great as to counterbalance the internal distention.

The operation of external pressure partially applied, ought also to be taken into account. I do not pretend to refuse, that there is an original difference in the form of the skull. I am also fully persuaded, that much of this variety may fairly be imputed to the different means of compression, which the customs of different nations have introduced: hence the skull may receive a peculiar, and what may perhaps be called *national* character, from some peculiar artificial method of applying pressure [*].

HIPPOCRATES [†] goes further, and seems to be of opinion, that an artificial form of the head, the result of the above singular custom practised for several generations, has at length become hereditary; and constitutes the national peculiarity.

---

[*] HERODOTUS. Vid. fig 1. plate xxi, and also fig. 2. of the same plate.

Vid. ADAIR's Hist. of the American Indians.

CONDAMINE, Mem. de l'Acad. des Sciences de Paris, 1745.

[†] HIPPOCRATES states his opinion, that the remarkable form of the heads of the *macrocephali* is the effect of pressure; and observes, " Quum recens infans natus est, caput ejus, adhuc tenerum ac molle existens, quam celerrime constringunt manibus, coaptantesque cogunt in longitudinem augeri; quin et vinculis connectunt, ac aptis instrumentis colligant, quo rotunditas capitis prohibeatur, ac longitudo augeatur. He has added, Temporis vero progressu, natura quoque tales produxit, *ut non esset necesse consuetudine priore cogere* [‡]."

[‡] De Aere, Aqua, et Locis. Edit. Vanderlinden.

Of the Changes in Size and Shape which the Head undergoes during the different stages of Hydrocephalus Chronicus.

The changes in size and shape which the head undergoes during the different stages of *hydrocephalus chronicus,* also afford a striking illustration of the influence of the brain upon the form of the skull, and also of the effect of posture and pressure.

In consequence of this disease, the head soon acquires a preternatural size * and form.

Before proceeding to endeavour to explain the form of the skull in the different stages of hydrocephalus chronicus, it may not be improper to observe, that when the forehead is naturally very prominent, as we observe in some families, it becomes very remarkably so from hydrocephalus chronicus †.

The uniform and equal growth of every part of the bones of the brain-case may be stinted, or its shape distorted by posture.

---

* I have seen the skull of a person who died from hydrocephalus, which measured fifty inches in circumference.

† Vid. Case which I published in Dr Duncan's Annals of Medicine for 1803.

I have described * two cases, which afford striking examples of the operation of posture and pressure in modifying the form of the head. In the former, from the boy sleeping most frequently on his back, the back-part of the head on which he rests has become flat: and as, in the latter case, the child was suckled at one breast only, the pressure of the mother's arm prevented the one side from bulging out so much as the other.

I have endeavoured to shew that the brain serves as a mould upon which the skull is formed ; and the following observations seem to me to afford still farther evidence in support of that opinion.

It seems probable, that in the hydrocephalus chronicus, there is not the usual balance betwixt the actions of the arterial and absorbent systems. The arteries of the brain do not secrete the usual quantity of medullary matter, while the absorbent vessels, in consequence of distention and pressure, act much more powerfully than usual, and remove a considerable portion of the brain.

In many instances, on dissection, almost the whole substance of the brain has been found removed ; and its cavities have been so distended, that the brain itself seemed only a thin lining to the dura mater.

In such a morbid state, the water contained within the ventricles will push the brain outwards, and separate the pieces of the cranium to a great-

---

* Vid. Dr **Duncan's** Annals of Medicine for 1803.

er or less distance, in proportion to the quantity of water effused.

The preceding observations appeared to me necessary to the more perfect understanding of the changes which the head undergoes, in shape and size, in the successive stages of hydrocephalus chronicus.

Keeping these in view, and marking the progress of ossification, with the mode of attachment of the different bones of the skull, the phenomena that present themselves appear to admit of a satisfactory explanation.

It is obvious, that where the internal pressure is greatly increased, and the bones of the skull give way, that this enlargement must be unequal, owing to the unequal resistance.

As the chief circumstances, upon which this unequal resistance depends, in my opinion are the progress of ossification, and the connection of the different bones of the head, I shall now proceed to explain the effect of these more fully.

From the imperfect ossification of the bones of the head, when the child is born, it follows that when the disease originates while the fœtus was *in utero*, the skull must more readily give way, and more readily acquire a large size, than when the disease occurred at a later period of life, and where the bones of the skull were burst assunder, after having been previously united.

In proof of which, the head of one of my patients, though it had attained a large size before birth, increased six inches in circumference in the course of nine months; and, in another instance, the child, when nine months old, required a hat fit for a child four years old.

As the skull after puberty rarely gives way, the brain must be much compressed; which compression speedily leads to stupor, convulsions, and death, or to the hydrocephalus acutus.

The form of the skull of the fœtus is very different from that of the adult: in the former, *the skull projects remarkably at the original centres of ossification of its component pieces* *, and hence the the upper part of the skull of the fœtus is not so round as that of the adult.

In the adult, those prominences which are very apparent in the fœtus disappear, owing to the gradual growth and alteration of the shape of the brain, which serves as a mould on which the skull is formed; the skull adapting itself to the form of the brain.

But as, in consequence of hydrocephalus, the growth of the brain is checked, or in some measure suspended, the brain does not acquire its usual form; and as the brain is pushed outwards from the accumulation of water within it, the bones of the cranium, though they increase in size, *retain the form they had when the child was*

---

* Vid. Plate xxi.

born; and the ossific spiculæ, instead of describing portions of spheres, as they do at a later period of life, describe only straight lines from their centres of ossification *.

Hence the head of a child labouring under hydrocephalus chronicus, notwithstanding its increased bulk, preserves for some time at least the form it had at birth *.

Some of the prominences on the head are more apparent than others: those on the fore-head especially are apparent even to the most superficial observer: the others also may be discovered by a careful examination.

These prominences, in cases of hydrocephalus, correspond in situation, as in the fœtus, with the original centres of ossification of the different pieces of the cranium *.

The os frontis in the fœtus is composed of two pieces. Two projecting parts are seen in the foreheads of all children labouring under hydrocephalus chronicus. There is also *a well-marked projection on each side of the head,* corresponding with the centres of ossification of the parietal bones.

There is only one projection in the upper and middle part of the os occipitis, which corresponds in situation with the largest piece of the os occipitis of the fœtus.

It also frequently happens, that there is a *marked inequality in the size of the projections on the op-*

---

* Vid. Plate xxi.

posite sides of the head, which gives the head a distorted appearance; and in some instances, such inequality in the growth of the cranium takes place at the back-part of the head; in others, in the forehead.

In one of the cases which I met with, that part of the head which is opposite to the centre of ossification of the right parietal bone, is more prominent than the same part of the skull on the left side; but the skull on the right side, underneath the prominent portion, is almost flat; whereas the corresponding portion on the left side bulges out, and forms a semicircular line downwards towards the neck.

In another case, *one side of the os frontis is much more prominent than the other*, and to such a degree, that if the profiles of both sides of the head were taken, no one would imagine them to represent different views of the same head: the one resembles the profile of a child whose *head is a little larger than usual;* whereas the other, from the forehead being very prominent, bears all the characters of the head of a child labouring under hydrocephalus chronicus.

May not the above fact be attributed to a larger quantity of water being effused on one side of the head than the other; the cause of which has been well explained in the following letter from my ingenious colleague Dr RUTHERFORD, to my Father: "I have seen," says he, "one of the ventricles much enlarged and full of water, while the other remained of its natural capacity, and contained hardly any water. This appearance, I should however impute not to the obliteration or obstruction of the communication between the lateral ventricles, but to one side of the brain being more affected with disease, more flaccid and tender than the other; in consequence of which, a greater exudation had taken place from the vessels of this part, and the sides of the ventricle had yielded more readily to the pressure of the water, as it was effused."

Such, in general, is the state of the head in the first stage of hydrocephalus chronicus; but it is proper to remark, that cases occur where some parts of the head are below the level of the others, which is probably owing to the ossification not being completed at those places.

During the progress of the disease, the head exhibits many striking varieties as to form and size. It never preserves its natural form. It acquires an unusual breadth; but especially at those parts *which correspond with the centres* of ossification of the parietal bones, and also *in the forehead.*

The effusion of a watery liquor into the cavities of the brain, which takes place to a greater or less degree in different instances, produces these effects *.

---

* The undulation of a fluid within the head, may be distinctly perceived at the sutures, if the watery liquor has been effused between the membranes of the brain; nay, even where it is ef-

The former change is owing to the separation of the parietal bones; the latter is the consequence of the separation of the upper part of the pieces composing the os frontis; (for the lower parts of the pieces of that bone, on account of their connections with other bones which are ossified at an early period of life, cannot recede from each other to any distance); and hence the face, instead of being nearly oviform, somewhat resembles a triangle, of which the brow makes the basis, and the chin the apex.

As the disease advances, *the forehead becomes unusually prominent*, to such a degree, as often to prevent the unfortunate sufferer from seeing objects above the level of his eyes.

During the continuance of the hydrocephalus chronicus, the distance from ear to ear, or the transverse diameter of the head is increased, and the width of the head is most remarkable between the centres of ossification of the parietal bones. A disunion takes place between the upper portions of the pieces of bone which compose the os frontis, which is the cause of the very remarkable breadth of the upper part of the forehead; and hence the forehead is somewhat of a conical form, the apex

---

fused within the ventricles, especially if the quantity of it be large; as in such cases, in consequence of the pressure by distention, a great part of the brain is absorbed, and a communication is formed betwixt the water which is effused between the membranes, and that within the ventricles of the brain.

of the cone being at the root of the nose, and the base of it at the upper part of the forehead.

From the continuance of the disease, owing to the water contained within the head elevating the *bregma*, and membrane between the parietal bones, the form of the head is still farther changed; *its upper part becoming somewhat of a conical figure.*

During the progress of the ossification, and from the internal distention continuing to exert its influence over the growing osseous fibres of the skull, which on account of their length and weakness, do not oppose as much resistance to the internal distention as the centres of ossification; hence the next change, is the *bulging out of the bones at the sides of the prominences,* which is the consequence of a very large collection of water within the head, and only occurs when the disease has been of two or three years standing.

The bones bulge out at the sides of the original centres of ossification of the pieces of the skull, which form the most resisting points; and hence, in this stage of the disease, the prominences in the skull corresponding with the original centres of ossification of the pieces of the cranium, are less apparent than in the head of a child who has laboured under hydrocephalus for a few months only.

It is hardly necessary to observe, that these changes in the form of the head take place more rapidly in some cases than in others.

The disease at its commencement, and for some time after, affects only the bones of the cranium; but, in process of time, the bones of the face are also enlarged, and become distorted, especially those of the orbits: and the distances between their outer angles are much greater; in one of the cases, it was greater by 1 inch and $\frac{1}{4}$th, than in most men of twenty years of age.

Of the Progress of Ossification in the Sutures.

Should the unfortunate patient linger for some years under hydrocephalus, nature endeavours to give protection to the brain, by completing the ossification of the skull; the progress of which, and all the symptoms which it gives rise to, I shall endeavour to describe.

This process, probably from the diseased state of the vessels, takes place imperfectly and unequally; so that, in some instances, instead of the whole void being filled up by bony matter, for many months only a few pieces of bone, of unequal sizes and irregular figures, are formed in some of the sutures; and in other instances, as in Case I., the ossification is not completed for years.

This gives rise to the sensation which the mother of the boy nine years of age, so strongly expressed: she said, that her son's head, about eighteen months before, seemed to her as if it had been broken in several places; but now, that the whole was consolidated: for the detached pieces of bone in the membranes uniting, the bones of the cranium have, in the progress of ossification, adhered firmly to them.

The ossification takes place at different times in the different sutures.

The membrane uniting the pieces of the os frontis, is generally ossified when the child is between its twelfth and twentieth month.

The membrane betwixt the os occipitis and parietal bones, is not ossified until a much later period of life; and the sagittal and coronal sutures were not ossified in the boy of nine years of age.

These membranes are of unequal breadth; that between the two pieces of the os frontis, and that between the parietal bones being broader than the others, allow these bones to recede from each other to a considerable distance, and hence, as has been already observed, the head acquires an extraordinary breadth. From a similar cause, the os occipitis is also protruded; and were it not owing to the patient generally resting on the back-part of his head, that part of the head would also become very prominent.

In short the head acquires its unusual bulk, in part from the greater size of the pieces of the cranium-case, and also from the ossification of the membranes which unite these different pieces together.

Having described the changes which take place in the size and form of the head, during the successive stages of hydrocephalus chronicus, I shall conclude, by adding a few remarks on the thickness of the skull, and on the changes which the other bones of the body undergo in consequence of this disease.

On account of the great size of the head, the bones of the cranium are generally thinner than in the healthy state; and a case is quoted by VAN SWIETEN *, in which the bones of the cranium became nearly transparent.

In some instances, every portion of the skull has not been ossified, some spots of the brain being covered by membrane instead of bone †.

When sheep are attacked by hydrocephalus, or when hydatids are lodged within their brains, the earthy part of the skull opposite to the seat of the disease is removed by absorption; that part of the skull becomes soft, feels like a piece of wet pasteboard, and may be cut through, without turning the edge of the knife.

But in the human subject, the reverse of what has been already described, sometimes, though rarely, takes place; for the bones of the skull, instead of becoming thinner, become thicker than common, in consequence of hydrocephalus chronicus ‡.

---

* "Ossa tamen capitis tenuia erant adeò, ut irradiante lumine pellucerunt, sic ut interiora capitis videri potuerint." Vid. vol. iv. p. 122. quarto edition, published at Leyden.

† Vid. Plates of Dr BAILLIE's Morbid Anatomy, Fasc. 10.

‡ Vid. DU VERNEY, Traité des Maladies des Os, tom. ii. pag. 8.

Morgagni * informs us, that even the other bones of the body partake of the disease, and are much altered in shape. Such a change, I believe, rarely occurs; although I have no doubt, that in almost all cases of hydrocephalus chronicus, the bones of the skeleton are, as the soft parts, of a more slender form, thinner and smaller than usual; or that, even supposing the head of the usual size, the rest of the body will be found not to bear the same proportion to it as in a healthy child.

Observations on the Smaller Varieties in the Form of the Skull, and on Craniometers.

From what has been stated respecting the form of the skull, and also respecting the various causes which determine its particular shape, it is evident, that the shape of the skull may be readily altered by a great variety of causes; as by external injury, by particular posture, or by disease.

There are many distinctions as to the shape of the skull, which have not been described, owing probably to our not being provided with a machine adapted to that purpose. Thus, for example, there is not a skull in a hundred, which is symmetrical, in which the opposite sides are exactly equal and parallel to each other. This observation holds true, even with regard to the os frontis, though in the adult it consists only of one bone; and it holds true with regard to the bones which surround the cavities of the nose, of the orbits[*], and also respecting the bony part of the mouth.

---

* Vid. Epist. xii.

Upon examining the under surface of the skull, the above observation also holds true, as may be seen by drawing a line from the more prominent part of the os occipitis, through the middle of the foramen magnum, ossis occipitis, and the bony palate, to the most prominent part of the upper jaw[†].

It would lead to a very long detail, entirely foreign to the object of mere Outlines on Anatomy, to point out all the defects as to the symmetry of the skull; many of which are obvious in the subjoined plates. I shall therefore content myself, by submitting to the reader, a machine by which these varieties in the form of the skulls, may be observed, and represented with truth upon paper.

The machines which have been employed for measuring the different angles of skulls, are imperfect, and may on some occasions mislead; for it is evident, that any little rising of the skull must alter the angle, which is taken by a wooden or metallic ruler, laid along the most prominent part of the os frontis and os maxillare superius, and crossed by another laid horizontally across the meatus auditorius externus: these instruments being made of unyielding materials, do not adapt themselves to the inequalities of the surface of the skull.

---

[*] There is no part of the skull which is so different as to its form, as the orbit[*]. That of the Hottentot very much resembles the orbit of the Chinese.

[†] Vid. Plate xx. A.

[*] Vid. plates 18th, 19th, and 20th.

In illustration of what I have affirmed, I shall take the os frontis as an example.

In the os frontis there are certain cavities, called *sinuses,* which scarcely exist at the period of birth, and which, during the progress of life, are constantly becoming larger: the common craniometer when applied to the os frontis, is laid along the most prominent part of this bone; it therefore gives the angle which is formed by the projecting os frontis opposite to the frontal sinus, but not the angle formed by the os frontis above the frontal sinuses; so that the os frontis has been sometimes described as being very prominent, while in truth it was the reverse, the projection being caused by the large frontal sinuses, and not by the whole os frontis; and I have seen several persons whose foreheads were remarkably prominent at the frontal sinuses, but in which, the upper part of the os frontis retreated nearly as much as in the greatest number of African skulls.

The above observation applies also to the skulls of quadrupeds; for in these the frontal sinuses are much more capacious and extensive, than in the human body: in some, as the elephant, they extend over the whole skull.

Such are the imperfections of the present *craniometers;* for which in my opinion, the one represented in plate xx. A. might be substituted. This craniometer consists of four pieces of wood or brass, divided into inches, and properly subdivided, and one of which may be moved either in a horizontal or in a perpendicular direction; and for the sake of still greater accuracy, a Nonius or Vernier is added to one of the sides. Holes are perforated at each inch or half inch of the sides of the instrument, for the purpose of affixing silk threads, which are stretched from one side of the instrument to the other, by which a number of small squares are formed. By placing a skull behind these squares, as in plate xx. A. the form of the skull is seen with accuracy by dividing paper in a similar way. It may be copied, or reduced with mathematical accuracy, and every deviation from the most common shape, may be traced and represented on paper, by one who has attained but little proficiency as a draughtsman.

Explanation of Plate 17th.

This engraving is a fac simile of a drawing by the late justly celebrated Dr Peter Camper.

AA, point out the os frontis.
B, one of the ossa parietalia.
C, the os occipitis.
D, the os temporis.
E, the temporal process of the sphenoid bone.
F, the os malae.
G, the os maxillare superius.
H, one of the ossa nasi.
I, the under jaw.

K, the angle of the under jaw.

L, the condyle of the under jaw.

M, the zygomatic process of the temporal bone joining with the zygomatic process of the cheek-bone.

N, the sagittal suture.

OO, the squamous suture.

PP, the lambdoidal suture.

RR, the teeth.

Explanation of Plate 18*th.*

In this engraving, the skulls are represented in such a point of view, as seems to me to give the most complete idea of their form.

Fig. 1. is a remarkably well formed skull of a native of this country, of twenty years of age.

1 points out the os frontis.
2 one of the ossa parietalia.
3 one of the ossa temporum.
4 4 the ossa malarum.
5 5 the ossa maxillaria superiora.
6 6 the ossa nasi.
7 one of the ossa unguis.
8 8 8 8 the incisores teeth.
9 9 the canine teeth.
10 10 the smaller molares.
11 11 11 the three larger molares.

Fig. 2. this engraving was copied from the skull of a Russian, which is nearly of a globular figure.

Fig. 3. this engraving was copied from the skull of a Turk. The globular form of the skull, and great size of the bones of the face, and especially of the ossa maxillaria superiora, are the most striking features of this skull.

Explanation of Plate 19th.

Fig. 1. was copied from the skull of a Hindoo, which I received from Mr Thomas, surgeon in London.

Fig. 2. was copied from a skull of an Esquimaux, which was sent to my colleague Professor Jameson. The fore-head is narrow, the skull flat at its sides, and the superior maxillary bones remarkably large.

This skull differs a good deal from those represented by Blumenbach *.

Fig. 3. was copied from the skull of a Negro.

This view does not give a good idea of the cranium of the Negro; for the retreating forehead, and flatness of the occiput, are the most remarkable features of it.

The great size of the bones of the face and of the teeth, is very apparent.

Explanation of Plate 20th.

In this plate three very remarkable skulls are represented.

Fig. 1. represents the skull of a Carib, of the Island of St Vincent, which, in consequence of pressure having been applied to the forehead, is much distorted. It may be mentioned, that this specimen perfectly agrees in its characters with a skull of the same nation, in the museum of Mr Cline; and also with one in the possession of Dr W. E. Leach.

The forehead is remarkably flat, as also the sides of the head.

There is a ridge on the vertex of the skull.

---

* Vid. Cartwright's Journal during a residence of nearly five years on the coast of Labrador.

The bones of the nose are very long, and the distances between the orbits are of a very peculiar shape, and differently placed from those of the other skull.

The under part of the occipital bone is much flattened.

Thibault, De Chanvalon and Labat bear testimony, that this very remarkable form of the skull, is the result of pressure artificially applied.

Labat, tom. ii. p. 72, has observed,—" Les Caraibes sont tous bien faits et bien proportionnés ; les traits du visage assez agréables. Il n'y a que le front qui paroit un peu extraordinaire, parcequ'il est fort plat et comme enfoncé. Ils ne naissent point comme cela, mais ils forcent la tête de l'enfant à prendre cette figure, en mettant sur le front de l'enfant nouveau né une petite planche liée fortement derriere la tête, qu'ils y laissent jusqu' à ce que le front ait pris sa consistence, et qu'il demeure applati, de manière que sans hausser la tête ils voyent presque perpendiculairement au dessus d'eux."

Fig. 2. was copied from a remarkably fine specimen of a New Hollander, for which I am indebted to Mr Harrison of London.

The engraving is so accurate and so characteristic, as to require no illustration.

Fig. 3. was copied from a portion of the skull of a Mummy, which is filled with pitch.

It is the most remarkable skull in point of form, which I have ever seen, or seen represented.

It is narrower than common between the external angular processes of the frontal bones, measuring only three inches and three quarters : the transverse diameter behind, between the junctions of the squamous and lambdoidal sutures on the opposite sides of the skull, measured only four inches and a quarter, whereas most skulls, at the same place, measure six inches or nearly so : the distance from before to behind, was, by the callipers, eight inches and three quarters; and the upper part of the skull *forms an arch*, of which the middle of the os frontis constitutes one extremity, and the most prominent part of the os occipitis, the other. From the most prominent or highest part of the arch, near the middle of the sagittal suture, to the fore part of the foramen magnum ossis occipitis, the distance was $5\frac{5}{8}$ inches, being little more than $\frac{1}{8}$th of an inch greater than in most skulls: hence it appears that the pressure applied to the sides of this skull, had added very little to its depth.

Such a remarkable deviation from the natural form of the skull, and a form which is so different from the skulls of other mummies, which have been carefully examined by Blumenbach, Middleton, &c. could only, in my opinion, have been the effect of lateral pressure artificially applied.

Explanation of Plate 20th A.

This plate represents the under-part of the skull of the Carib, in order to shew how much it has been distorted, probably also by pressure artificially applied.

This plate also represents the Craniometer applied.

ABCD, the different sides of the instrument, which are divided into inches and half inches.

E, the nonius applied.

FFFF, threads stretched from the opposite sides of the craniometer.

G, points out its occiput.

H, the alveolar processes of the skull.

I, the foramen magnum ossis occipitis.

KK, the occipital condyles.

L, the cuneiform process of the os occipitis.

M, the palatine plate of the os maxillare superius.

N, the zygoma.

POSTSCRIPT.

Since the preceding sheet was printed, the following singular case has occurred to me.

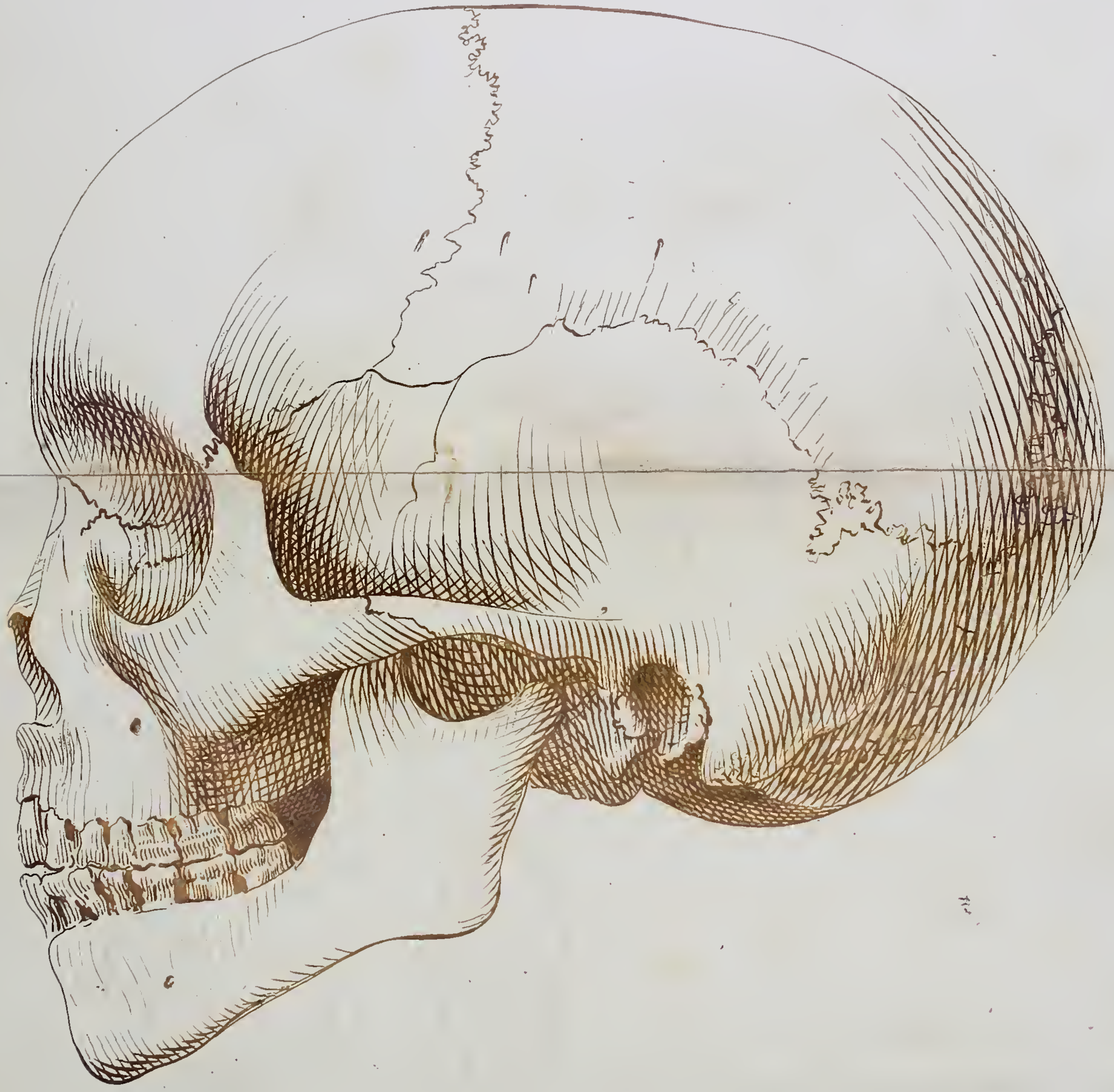
The patient, a woman about eighteen years of age, has a tumour of a hemisphericalshape, extending from the junction of the frontal with the parietal bones, very near to the junction of the sagittal and lambdoidal sutures. There is no part of the tumour which is not covered by bone; its bulk is not diminished by pressure with the fingers, nor does such pressure produce pain, vertigo, or coma.

This tumour attracted the patient's notice about two years ago, when about the size of a pigeon's egg; since which, it has gradually increased.

That the unnatural swelling had been owing to a morbid state of the brain, is obvious from the symptoms.

A little more than two years ago, she lost the power of moving her right foot, attended by weakness and numbness, and a sense of coldness upon the right side, even when sitting before the fire; in walking, she may be said to drag, rather than to lift her right leg; she cannot raise her right arm readily, so that in taking her food, she is obliged to stoop forwards. She has also much pain in her back, and is unable to stand, or even to sit up for any length of time, and occasionally cannot turn herself in bed. Of late she has frequent excruciating headachs, and constant vertigo, and cannot walk without aid. About the middle of March 1812, her sight was much impaired; she cannot sew, and occasionally sees double.

This case therefore affords a striking illustration of the influence of the brain in determining the form of the skull, and also proves, that, even after puberty, the skull may undergo a great change in its form, in consequence of a disease of the brain, or its investing membranes.



[illegible] delt [illegible]

PLATE XVIII

FIG. 3

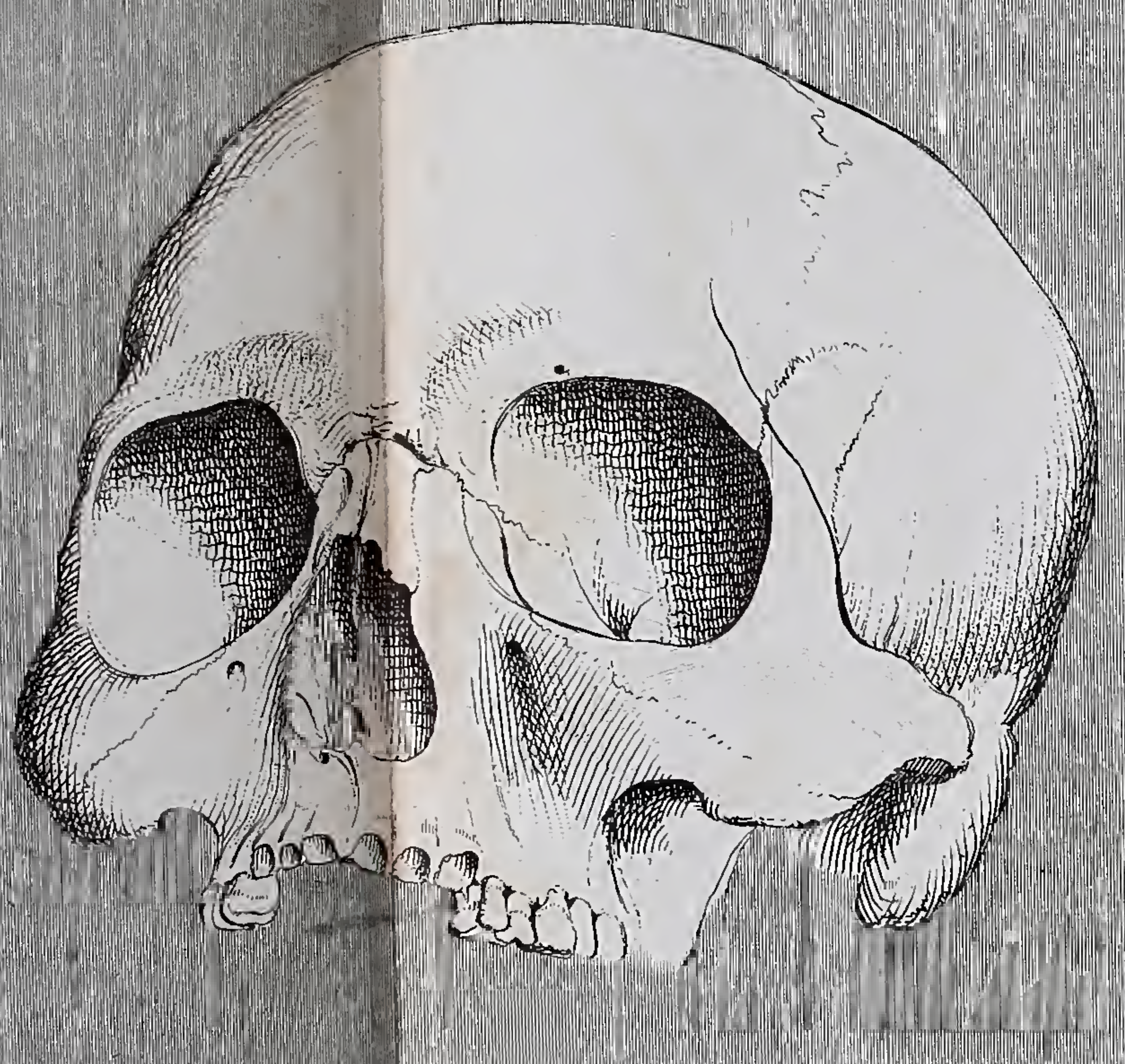


FIG. 2

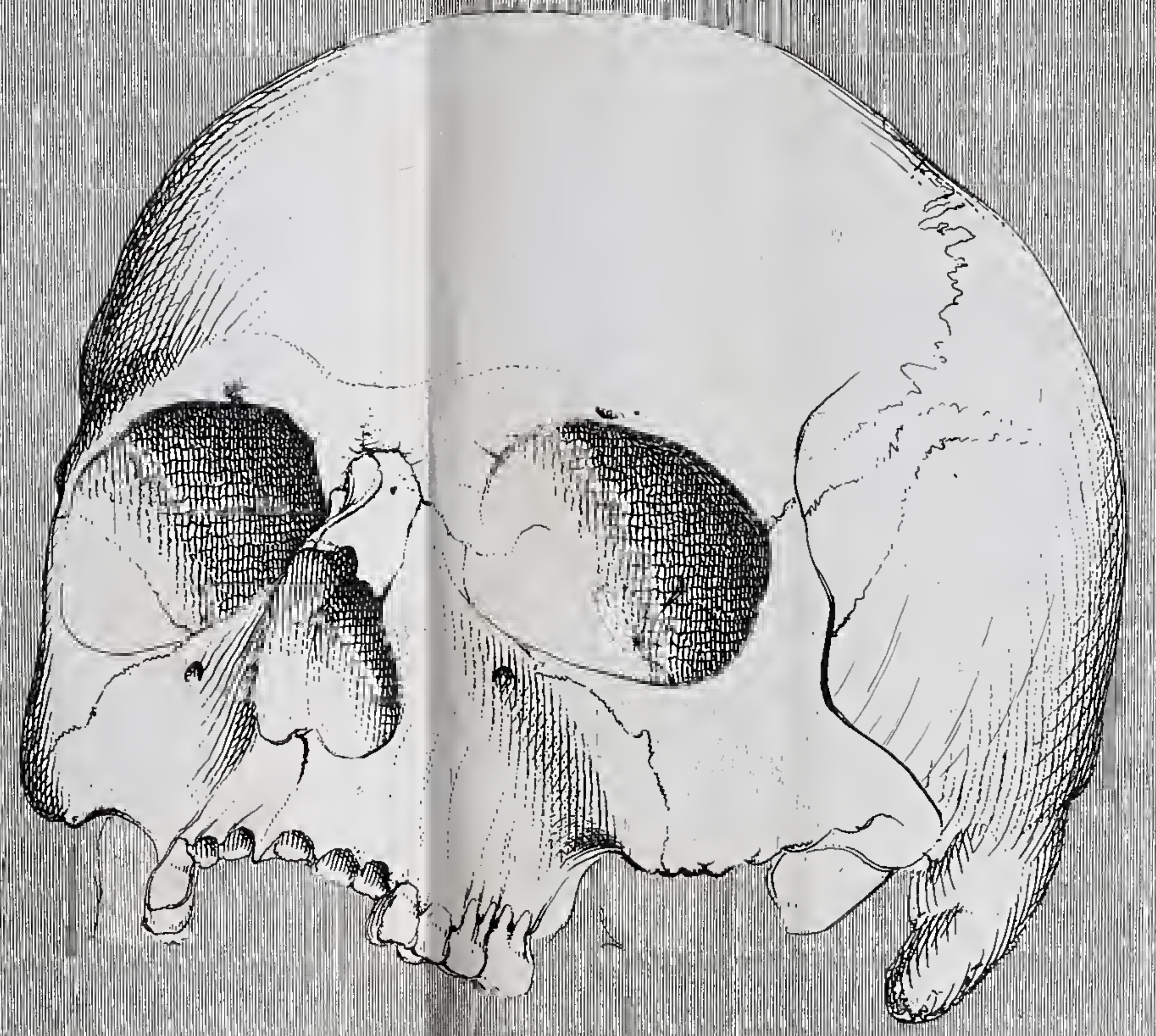


FIG. 1

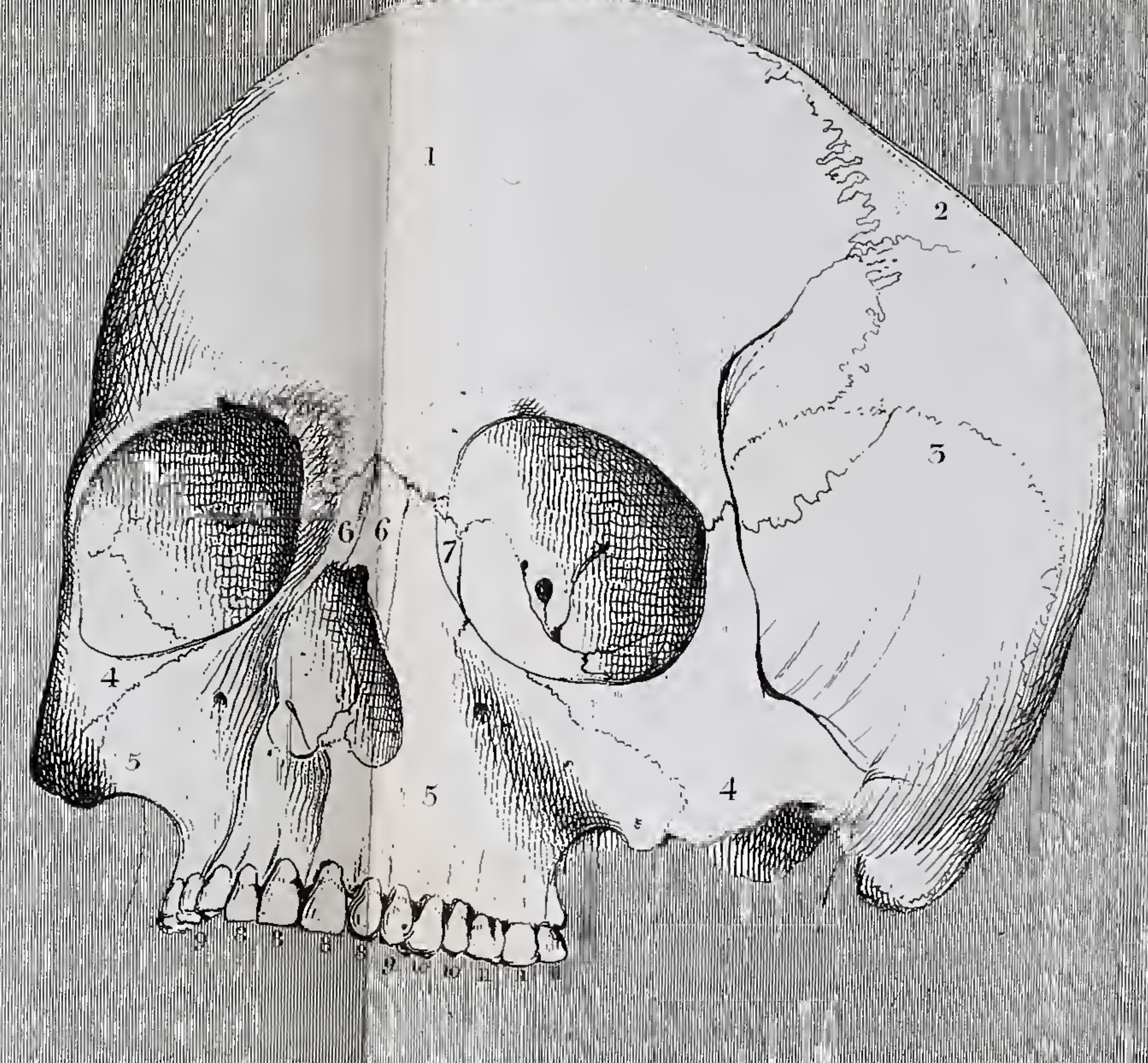


PLATE XIX.

FIG. 3.

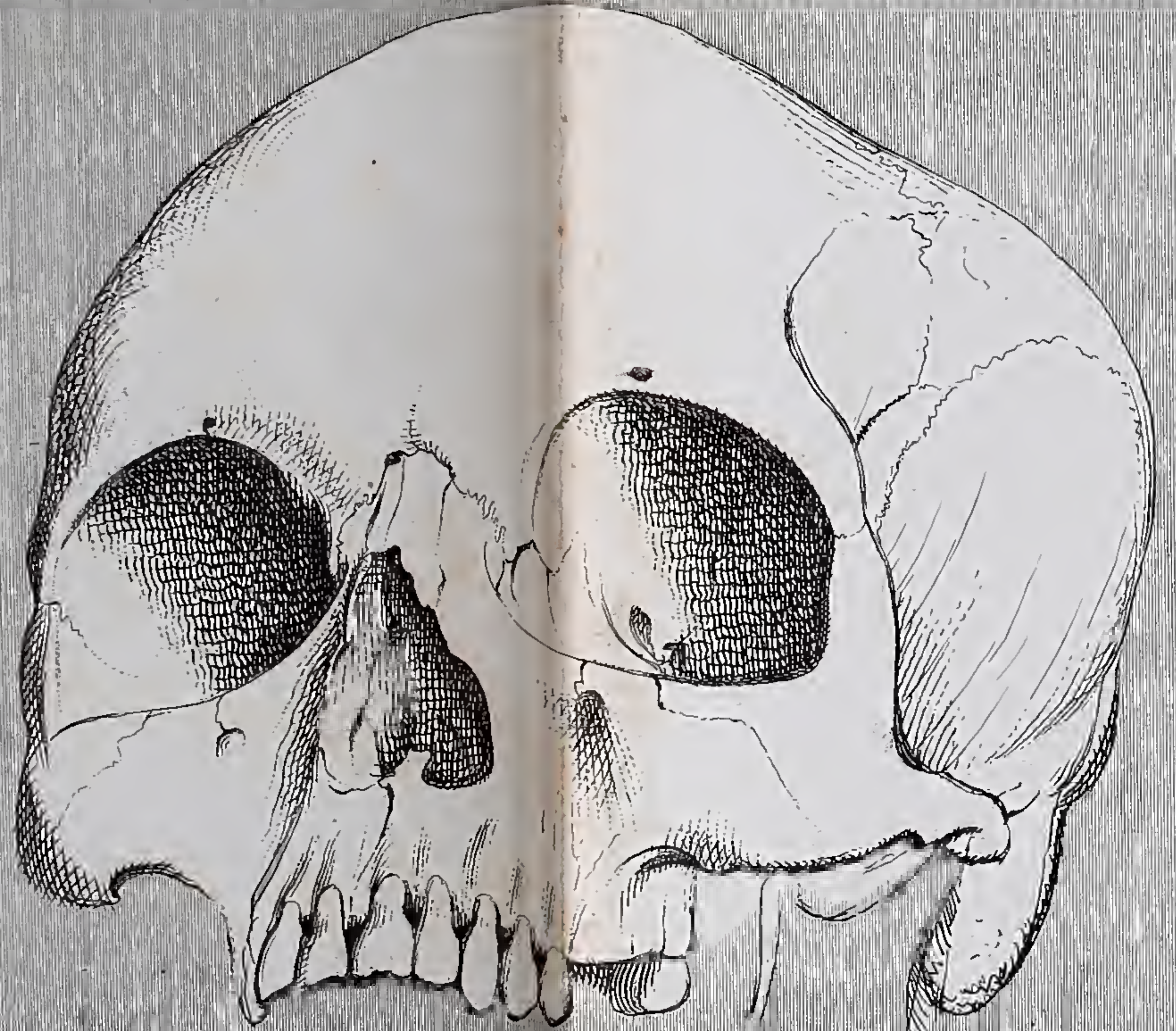


FIG. 2.

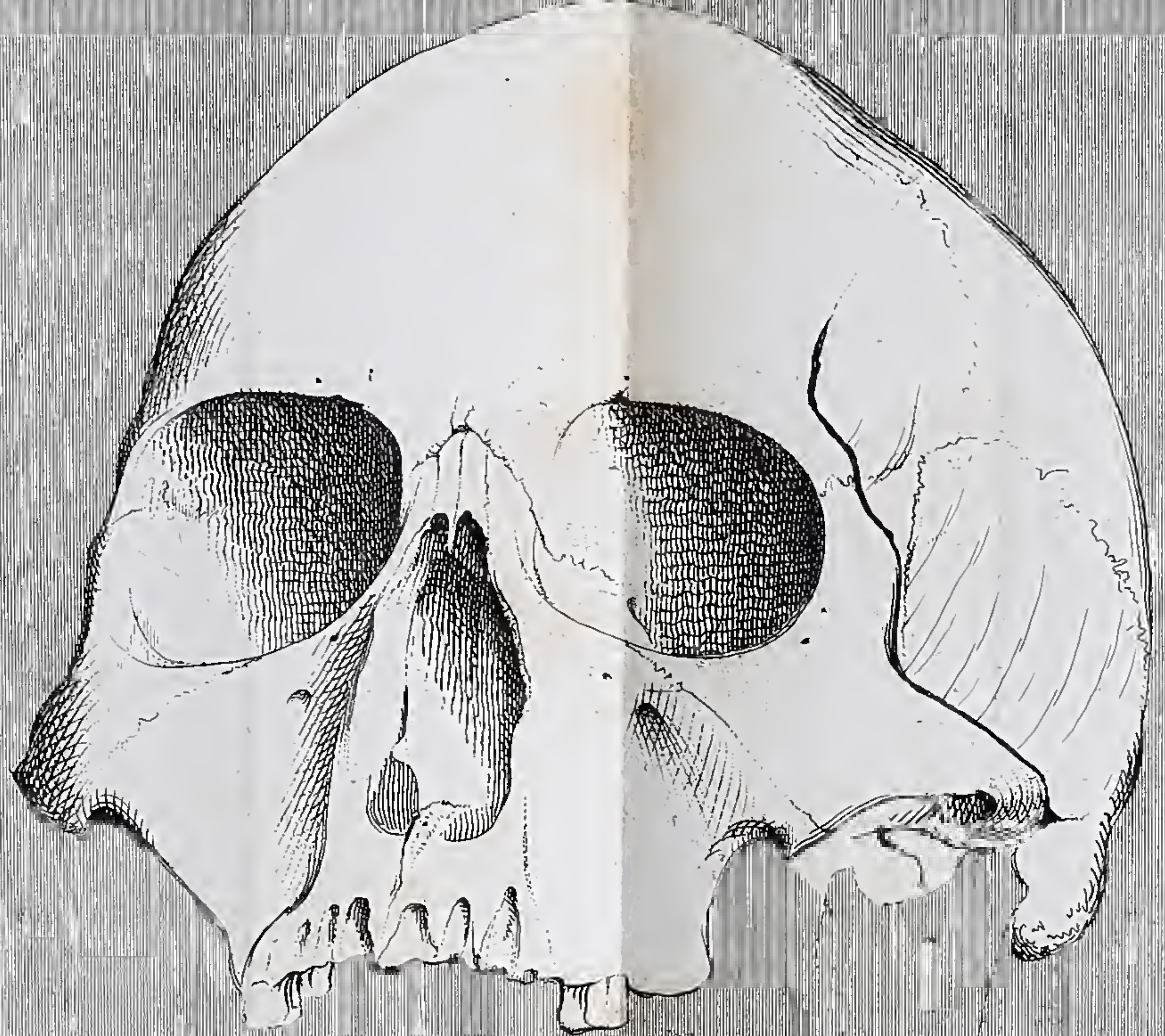
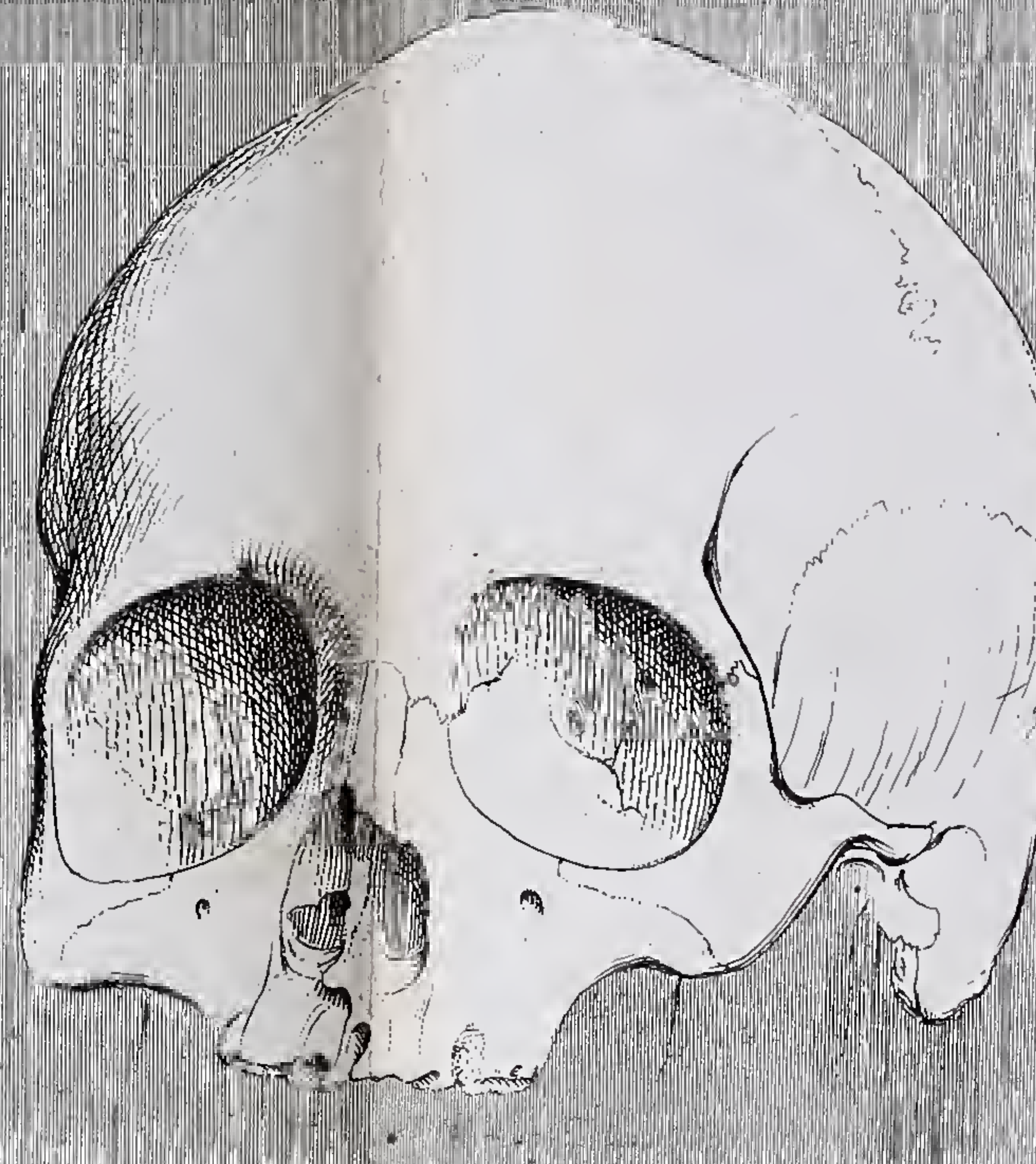


FIG. 1.



[illegible]

PLATE XX

FIG. 3

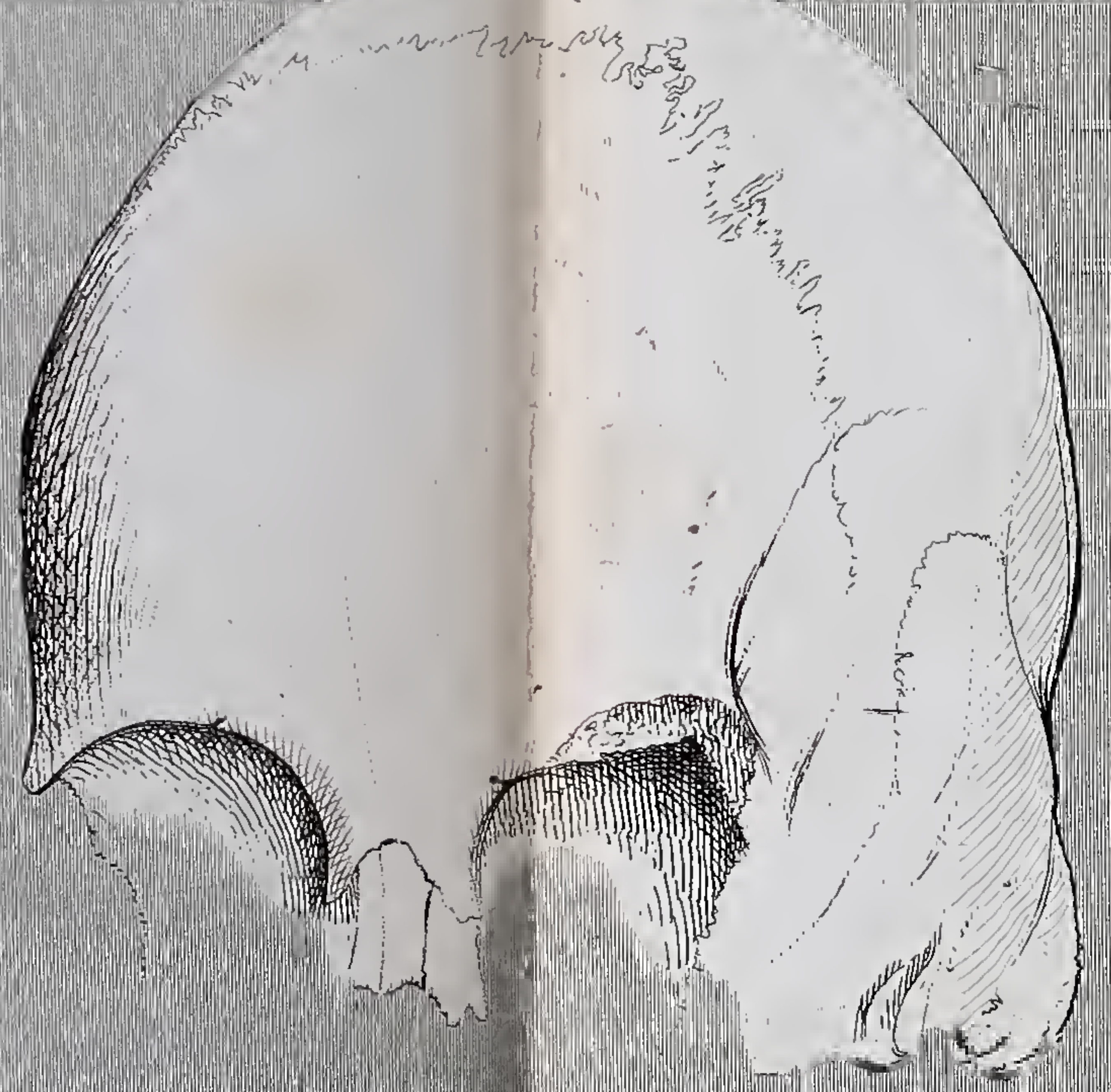


FIG. 2

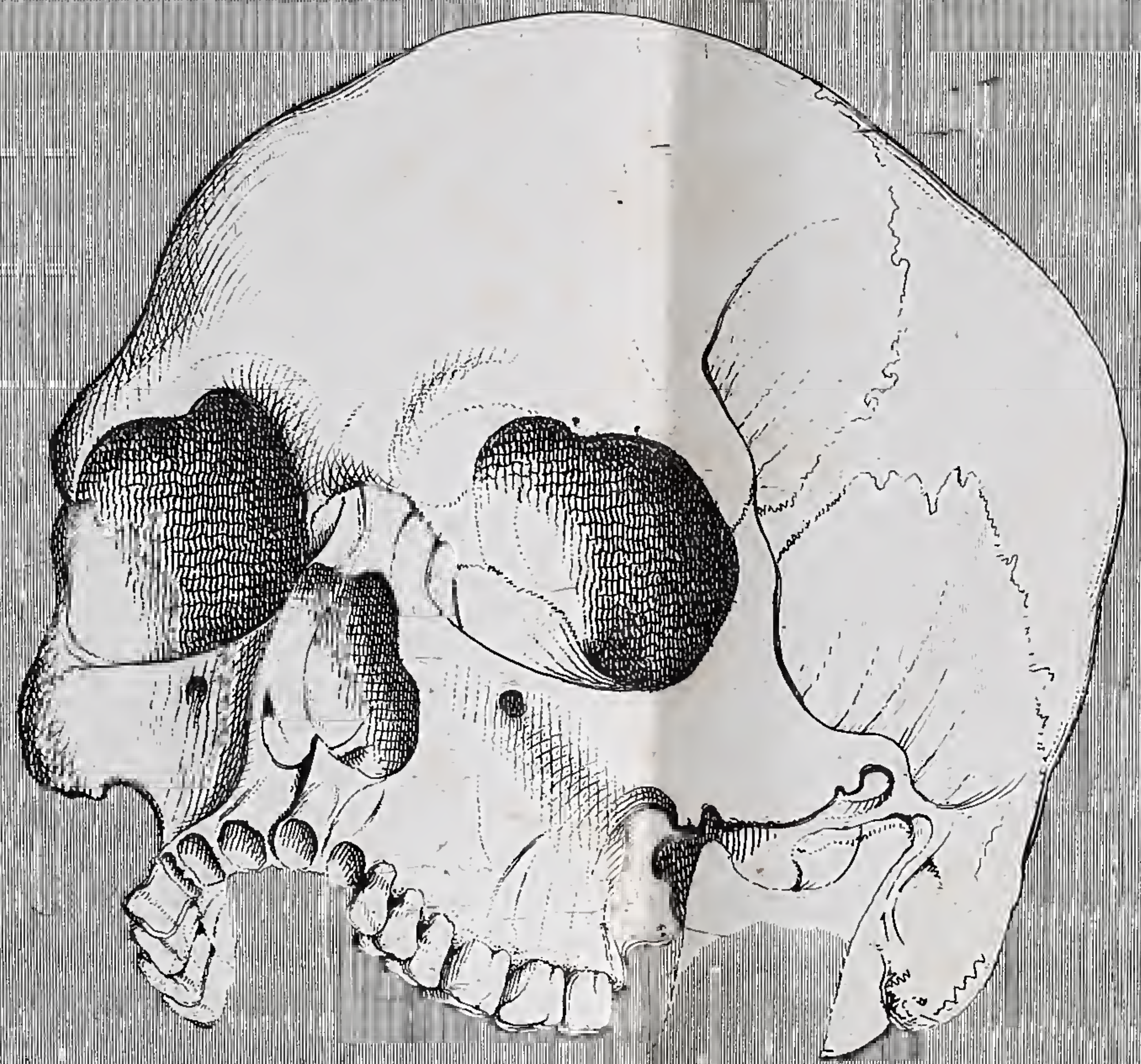
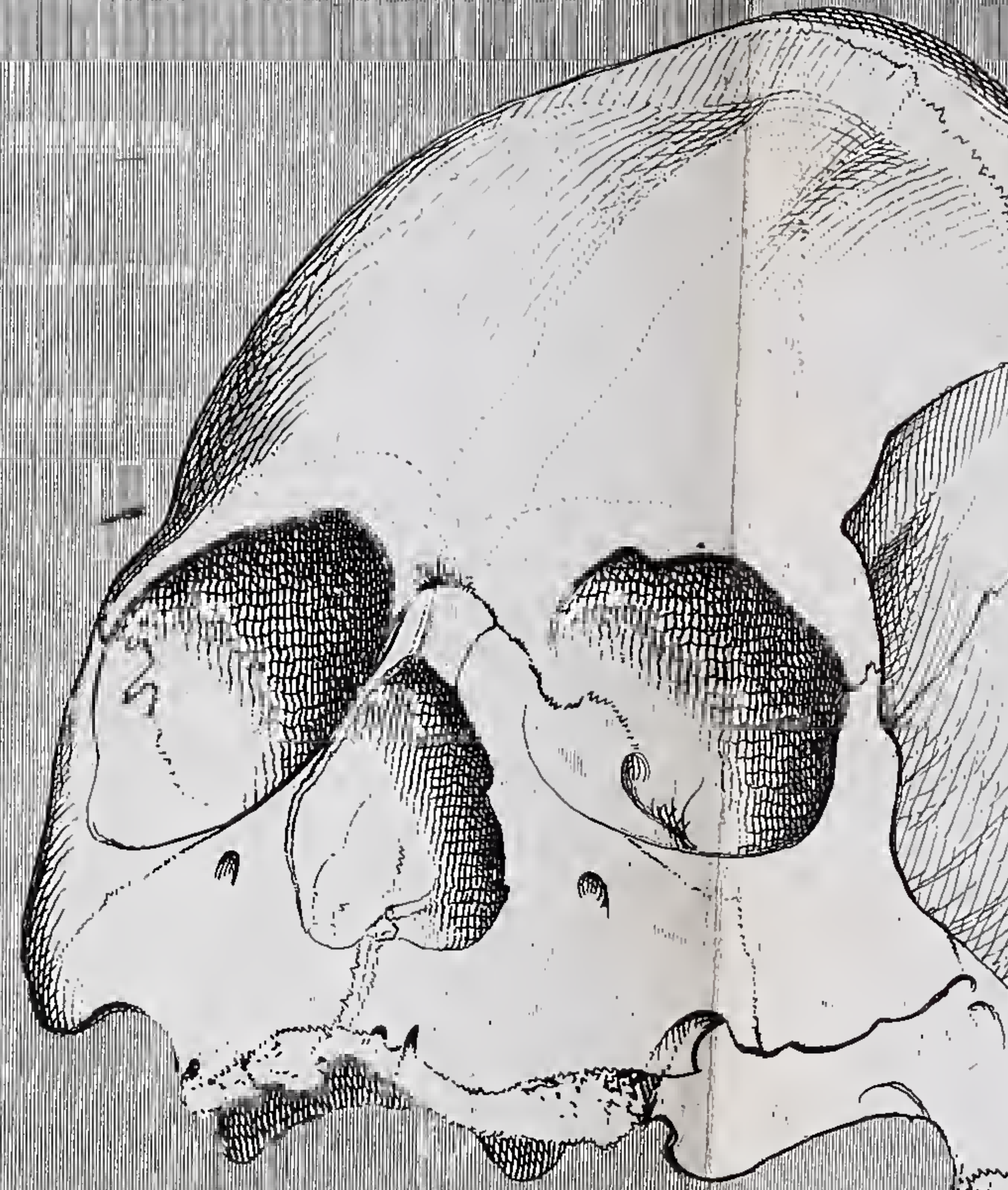


FIG. 1



Gul. H. Lizars del. et Sculpt ad Naturam

PLATE XX. A

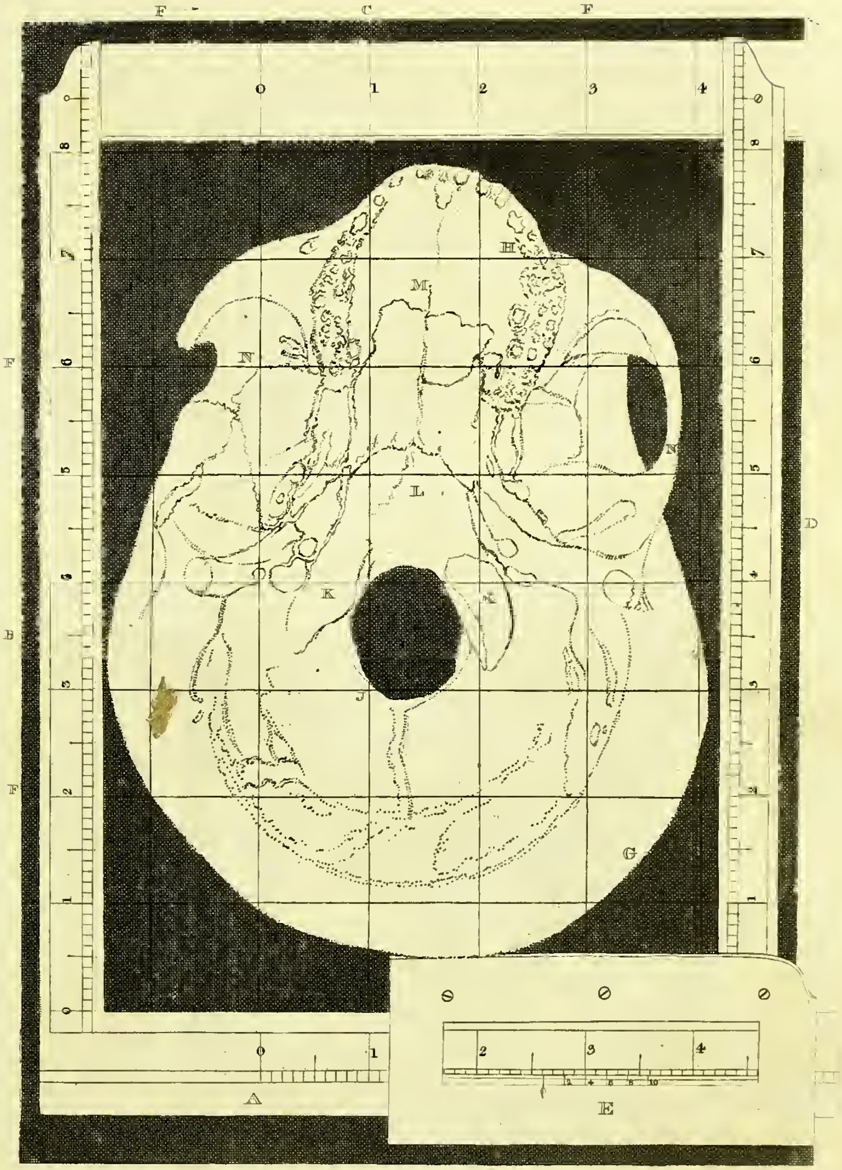
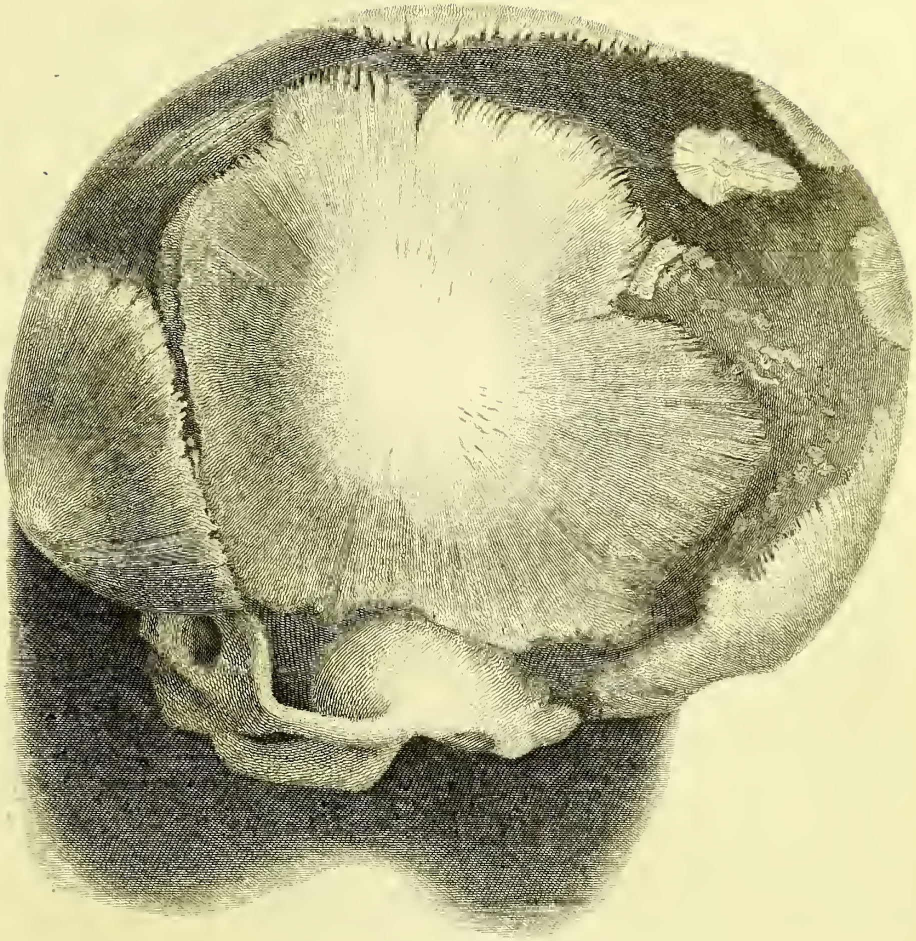


PLATE XXI.



[illegible] del.t

Engr.d by J. Heath